



8

Role of the infectious diseases service in antimicrobial stewardship

# Antimicrobial Stewardship in Australian Health Care

2018

Please note that revised antimicrobial stewardship actions are included in the Preventing and Controlling Infections Standard, which was released in May 2021. This version of the Standard supersedes the 2017 Preventing and Controlling Healthcare-Associated Infection Standard. The AMS Book will be updated to incorporate reference to the 2021 Standard.

# Chapter contents

<b>Acronyms and abbreviations</b>	<b>198</b>
<b>8.1 Introduction</b>	<b>199</b>
<b>8.2 Leadership</b>	<b>199</b>
8.2.1 Participating in the antimicrobial stewardship team and committees	200
8.2.2 Implementing and maintaining antimicrobial policies and guidelines	201
<b>8.3 Expert advice</b>	<b>201</b>
8.3.1 Specific situations requiring infectious diseases physician expertise	202
8.3.2 Support for external organisations	203
<b>8.4 Support for formularies and approval systems</b>	<b>204</b>
8.4.1 Formularies	204
8.4.2 Approval systems	204
<b>8.5 Prescription review with feedback</b>	<b>205</b>
8.5.1 Antimicrobial stewardship team rounds	205
8.5.2 Conflicting advice	205
<b>8.6 Monitoring antimicrobial use and evaluating interventions</b>	<b>206</b>
<b>8.7 Liaison</b>	<b>207</b>
8.7.1 Liaison within hospitals	207
8.7.2 Interacting with the pharmaceutical industry	207
<b>8.8 Role in education</b>	<b>208</b>
<b>Resources</b>	<b>209</b>
<b>References</b>	<b>209</b>

## Acronyms and abbreviations

Abbreviation	Definition
AMR	antimicrobial resistance
AMS	antimicrobial stewardship
ICU	intensive care unit
ID	infectious diseases
LHD	Local Health District
LHN	Local Hospital Network
IT	information technology
QI	quality improvement

## Key points

- Infectious diseases (ID) physicians play an essential role in antimicrobial stewardship (AMS), which needs to be considered when planning the AMS program and the composition of hospital and network AMS teams.
- Depending on activity, the involvement of at least one ID physician to contribute effectively to the development, implementation and functions of the AMS program is important to the success of the program.
- The roles of ID physicians include providing advice on the appropriate use of antimicrobials; developing and implementing evidence-based guidelines for antimicrobial treatment and prophylaxis; and contributing to formulary decision-making, antimicrobial restriction policies, and the establishment and operation of antimicrobial approval systems.
- ID physicians are able to make a considerable contribution to the development and delivery of education to the workforce through formal education programs, through feedback provided at forums such as grand rounds, or as part of an AMS intervention.

## 8.1 Introduction

The effectiveness of many of the strategies to improve antimicrobial prescribing discussed in other chapters depends on a formalised multidisciplinary approach, including the involvement of infectious diseases (ID) physicians. Their expertise in the management of infectious disease and support for antimicrobial stewardship (AMS) activities is considered essential to the success of hospital AMS programs.<sup>1-3</sup> There is good evidence that the involvement of ID physicians in AMS programs improves antimicrobial use and clinical outcomes, and reduces the overall costs of antimicrobial therapy.<sup>4-6</sup>

ID physicians contribute to AMS in many ways, including by providing expert advice and educating clinicians. They have a major role in the development of antimicrobial policy and prescribing guidelines, formulary decision-making, and the establishment and operation of antimicrobial approval systems. The AMS committee and the AMS team should include an ID physician, if one is available.<sup>7</sup>

Issues that are especially relevant for certain settings – rural and remote hospitals, private hospitals and aged care – are tagged as R, P and AC, respectively, throughout the text.



## 8.2 Leadership

The involvement of ID physicians in the development, implementation and function of the AMS program, and collaboration with local specialists to ensure that the AMS team's goals are understood and met, is essential to effective AMS.<sup>1</sup> Clinicians caring for critically ill patients are more likely to follow an antimicrobial policy that is supported by their ID colleagues<sup>6</sup>, and ID physicians can gain prescriber acceptance of antimicrobial interventions by ensuring that there is no perceived loss of autonomy in clinical decision-making.<sup>8</sup>

Although guidelines recommend that the hospital AMS program be led by an ID physician<sup>1,3</sup>, that is not always feasible. Increasing numbers of programs are successfully led by clinicians without specialist ID training.<sup>9-11</sup> AMS programs require leaders with knowledge of quality improvement, organisational change, the measurement of improvement and the conduct of effective programs. ID physicians with responsibility for leading programs are encouraged to develop skills in these areas. Typical responsibilities of ID physicians who lead AMS programs are shown in Box 8.1.

Principal Referral Hospitals and Acute Group A Hospitals should consider having at least one ID physician (or clinical microbiologist) on site to participate in AMS activities.

## Box 8.1: Responsibilities of a lead infectious diseases physician

The infectious diseases physician's responsibilities in leading an antimicrobial stewardship (AMS) program include:

- Coordinating the development of an implementation plan for the AMS program that
  - responds to the requirements for AMS of the National Safety and Quality Health Service Preventing and Controlling Healthcare-Associated Infection Standard\*
  - incorporates the Antimicrobial Stewardship Clinical Care Standard
- Working with the AMS committee to set up and evaluate program goals
- Establishing and maintaining the AMS committee and/or team
- Integrating the functions of the AMS committee and/or team with those of the drug and therapeutics committee, and the infection prevention and control committee
- Coordinating the analysis and reporting of antimicrobial use data

- Recommending audits of prescribing and clinical indicators
- Ensuring the availability of a process of feedback on antimicrobial prescribing to prescribers and the AMS committee and/or team
- Advising on workforce education programs on AMS and antimicrobial prescribing
- Identifying responsibility for
  - developing, implementing and maintaining prescribing policies (including antimicrobial formulary and restrictions), guidelines and clinical pathways
  - collecting and reporting data on antimicrobial use and quality improvement measures
  - resourcing the above activities
- Reporting on the effectiveness of the AMS program to the organisation's clinical governance unit.

\* For relevant health service organisations  
Source: Adapted from Nathwani et al.<sup>2</sup>

Smaller hospitals employing a part-time ID physician can achieve improved antimicrobial prescribing and significant antimicrobial cost savings when the ID physician works alongside a clinical pharmacist to review prescribing and provide feedback.<sup>3,12-14</sup> In addition to a 42% decrease in antimicrobial expenditure, Day et al. reported improved susceptibility in *Pseudomonas aeruginosa* over three years following the introduction of a weekly review with feedback.<sup>13</sup>

### 8.2.1 Participating in the antimicrobial stewardship team and committees

International guidelines recommend that an ID physician be a core member of the hospital multidisciplinary AMS team, along with a clinical pharmacist with ID training.<sup>1,3,15,16</sup> (See also Chapter 2: 'Establishing and sustaining an antimicrobial stewardship program.')

ID physicians play key roles in AMS team reviews of patients who are prescribed highly restricted antimicrobials and in AMS ward rounds (see Section 2.4 in Chapter 2: 'Establishing and sustaining an antimicrobial stewardship program').

Large health service organisations may also have an AMS committee to oversee the implementation and ongoing function of the AMS program. The committee may be organised at the hospital level or at the Local Hospital Network (LHN)/Local Health District (LHD) level, and include at least one ID physician or a clinical microbiologist who may also act as the chair of the committee. ID physicians may also be involved in state, territory or national AMS committees.

## 8.2.2 Implementing and maintaining antimicrobial policies and guidelines

ID physicians have an important role in the development, implementation, review and audit of antimicrobial policies, prescribing guidelines, clinical pathways and bundles of care. This input is necessary to ensure that prescribing guidelines, restriction policies and other activities are based on the best evidence, and that patients are not placed at risk.<sup>1</sup>

Clinical guidelines developed for local use should accord with national guidelines, such as *Therapeutic Guidelines: Antibiotic*.<sup>17</sup> In conjunction with the AMS team, an ID physician should establish whether there is enough evidence to vary from national guidelines and advise on any changes, taking into account local antibiograms and antimicrobial resistance (AMR) patterns. ID physicians should take an active role in developing and reviewing antimicrobial policy and guidelines.

Noncompliance with prescribing guidelines is common. Barriers to appropriate guideline use by prescribers have been identified and need to be considered as part of the local implementation plan for introducing prescribing guidelines.<sup>18</sup> The collaboration of prescribers with ID and microbiology departments as part of AMS programs has been cited as a facilitator of compliance with AMS policy.<sup>19</sup>

Successful policy and guideline implementation requires the support of motivated individuals to enable change<sup>20</sup>, and research has shown that clinicians are more likely to follow a policy that is supported by their ID colleagues.<sup>6,21</sup> ID physicians should take an active role in planning and executing the guideline implementation plan. Buy-in from senior clinicians is critical, and the ID physician should actively engage with senior clinicians to gain support for new guidelines, clinical pathways and treatment algorithms. Along with other members of the AMS team, the ID physician should promote the antimicrobial prescribing guidelines and educate the workforce about them (see Section 3.2 in Chapter 3: '[Strategies and tools for antimicrobial stewardship](#)'). Guidelines and clinical pathways need to be regularly reviewed by the AMS team. The frequency of review may be routinely over a two-year cycle, or sooner if there have been major changes in protocols or new information about emergent antimicrobial resistance becomes available.<sup>2</sup> If local guidelines are developed, they need to be consistent with the latest version of *Therapeutic Guidelines: Antibiotic*<sup>17</sup>,

and local microbiology and AMR patterns. This requires the input of ID physicians and/or clinical microbiologists.

## 8.3 Expert advice

Many studies highlight the contribution of ID physician consultations to improved patient outcomes, including reduced mortality, morbidity and cost of care for patients.<sup>4,22-27</sup> The literature suggests that, when an ID physician is involved in patient care, there are improvements in diagnosis and treatment, and fewer relapses.<sup>22,23,25</sup> Improvements in patient outcomes associated with ID physician interventions have been reported for a broad range of ID diagnoses.<sup>25</sup> For example, ID intervention has reduced the 28-day mortality rate for *Staphylococcus aureus* bacteraemia.<sup>4,22-24,27</sup> Filice and Abraham concluded that treatment outcomes would be substantially improved if ID physicians were involved in all cases of *S. aureus* bacteraemia.<sup>23</sup>

ID consultations often result in changes to antimicrobial therapy, such as de-escalation to less expensive or narrow-spectrum agents, or the cessation of all antimicrobials.<sup>27-29</sup> In one point prevalence survey of antimicrobials used in Australian paediatric hospitals, Osowicki et al. found that inappropriate prescribing was significantly more common when there was no ID consultation. This was especially true for overprescribing, and for inappropriate choice of agent and application (dose, frequency or route of administration).<sup>30</sup>

The advice of an ID physician should be sought about:

- The initiation, de-escalation and cessation of antimicrobial therapy for individual patients (this can occur during AMS rounds)
- The need for therapeutic drug monitoring to maximise clinical activity and minimise adverse events caused by antimicrobial therapy
- Adjustment in the dose, frequency and route of antimicrobial administration in specific clinical situations (for example, management of sepsis and neutropenia) and specific patient groups (for example, neonates).

ID physicians can also play an important role in interpreting antibiograms and trends in AMR at local and national levels.

### 8.3.1 Specific situations requiring infectious diseases physician expertise

Specific situations in which the expertise of ID physicians may be required have been identified.

#### Specific infections

Early involvement of the ID physician can improve antimicrobial management (including choice of antimicrobial, dose, duration and assessment of response) for a range of infections. Examples of infections commonly recommended for ID consultation include infective spinal discitis or osteomyelitis, infected joint replacements, bacterial meningitis, infective endocarditis, *Staphylococcus aureus* bacteraemia, candidaemia, fever of unknown origin, febrile neutropenia in immunocompromised patients, and severe sepsis or septic shock.

#### Antimicrobial allergies

Penicillin allergy is the most common drug allergy and is reported in 5–10% of patients admitted to hospital.

Only 10–20% of patients labelled as having a penicillin allergy have a positive reaction to penicillin skin testing.<sup>31</sup> Patients labelled as having a penicillin allergy receive broader-spectrum, suboptimal and more toxic antimicrobial agents, and this is associated with increased AMR, cost, length of stay and mortality.<sup>32–35</sup>

Structured allergy assessments that include penicillin skin testing and oral challenge can be used to accurately de-label those patients who do not have a true penicillin allergy.<sup>31,36,37</sup>

An ID physician can advise on a procedure for improving the management of patients who report an antimicrobial allergy. This should include<sup>38</sup>:

- Obtaining and documenting an accurate and detailed history of the antimicrobial allergy by the AMS team (to differentiate immunological and non-immunological adverse drug reactions)
- Consulting with a provider experienced in performing and interpreting penicillin skin testing, unless the patient has a history of severe non-IgE mediated reaction (for example, toxic epidermal necrolysis or Stevens–Johnson syndrome)<sup>37</sup>
- Recommending antimicrobial rechallenge when allergy documentation reflects pharmacologically predictable side effects or mild non-IgE mediated drug reactions<sup>39</sup>

- Advising on appropriate alternative therapy for the management of infections in patients with true  $\beta$ -lactam allergy<sup>40</sup>
- Advising on desensitisation regimens to induce temporary tolerance in patients with true IgE-mediated reactions when no acceptable alternative antimicrobial is available.<sup>41</sup>

Using structured allergy assessments with penicillin skin testing to accurately de-label patients without a true penicillin allergy has been shown to decrease the use of certain antimicrobials (including vancomycin and fluoroquinolones) with no significant adverse reactions in patients, as well as to reduce the length of hospital stay and the costs associated with patient care.<sup>31,38,42</sup> Rimawi et al. reported an annual saving of US\$82,000 using skin testing to guide antimicrobial therapy.<sup>43</sup> Such testing should be undertaken by experienced clinicians. In the absence of immunology support, available personnel (including physicians and pharmacists, when adequately trained) can implement penicillin skin testing.

The Infectious Diseases Society of America recommends incorporating antimicrobial allergy testing of patients into AMS programs to increase the use of first-line agents.<sup>37</sup> A partnership between ID physicians, pharmacists and allergists/clinical immunologists is proposed as a preferred approach for antimicrobial allergy care that would enable antimicrobial allergy testing to be targeted to those requiring it.<sup>36</sup> A model for an integrated AMS and antimicrobial allergy de-labelling program has been described.<sup>31</sup>

#### Intensive care

AMR has emerged as one of the most important problems affecting the care and outcomes of patients in intensive care units (ICUs).<sup>44</sup>

The management of antimicrobial therapy in ICUs is challenging, and this area should be a focus for AMS in hospitals. ICU patients are highly susceptible to infections due to a number of factors, including their underlying illness, the use of diagnostic and therapeutic procedures that may be immunosuppressive, and the insertion of devices such as central venous catheters and endotracheal tubes for mechanical ventilation. Life-threatening infections such as bacteraemia and pneumonia predominate, and may be the reason for the ICU admission.<sup>45</sup> ICUs have the heaviest burden of antimicrobial use in the hospital<sup>46</sup> and, because of the need for early treatment of sepsis, use is often empirical. A further challenge is the complexity of the pharmacokinetics of antimicrobials in ICU



patients with altered volumes of distribution and clearance (for example, those with sepsis, on dialysis or receiving extracorporeal membrane oxygenation).

Infections in ICU patients are increasingly caused by multidrug-resistant and extensively drug-resistant organisms, and the management of these infections requires a good knowledge of the local epidemiology. Effective treatment requires an understanding of the likely effect of critical illness and sepsis on pharmacokinetics in order to determine appropriate dosing, especially for  $\beta$ -lactam antibiotics, for which continuous infusion may be employed.<sup>47</sup>

ID physicians have expert knowledge of the local epidemiology. They can contribute to the management of severely septic patients by using known susceptibility data for the causative organism, in combination with the patient's clinical status, to advise on the most appropriate agent, dose and dosing schedule. They can also advise on when to cease treatment or de-escalate therapy.<sup>48</sup> This advice can be provided as part of a consultation on an individual patient or during a regular AMS round. Box 8.2 provides some examples of outcomes achieved when ID physicians participate in ICU rounds.

### 8.3.2 Support for external organisations

ID physicians may have roles specific to individual hospitals, or may perform network-wide roles.

#### Hospitals

Smaller metropolitan hospitals, private hospitals, and rural and remote hospitals may engage ID physician support to:

- Provide clinical advice for the management of individual patients or specific issues
- Assist with setting up AMS programs
- Act as the administrators of an antimicrobial approval system.

This expertise may be provided through formalised arrangements such as contracting or networked arrangements, outreach arrangements from an established ID department, or other LHN/LHD arrangements. This may be part of a telehealth service model (see also Chapter 3: '[Strategies and tools for antimicrobial stewardship](#)' and Chapter 4: '[Information technology to support antimicrobial stewardship](#)').



#### Box 8.2: Examples of outcomes when infectious diseases physicians participate in intensive care rounds

Rimawi et al. described an intervention in a large tertiary university teaching hospital where, in addition to an existing antimicrobial stewardship (AMS) pharmacist, an infectious diseases (ID) fellow commenced daily AMS rounds with the intensivist and critical care fellows.<sup>49</sup> Recommendations included antimicrobial cessation, directed therapy based on culture results, conversion to oral therapy and alteration of duration; 81% of recommendations made were followed. Outcomes included a significant decrease in overall antimicrobial use, a decrease in broad-spectrum agent use, an increase in narrow-spectrum agent use, and cost savings with no associated change in all-cause intensive care unit (ICU) mortality. The

authors concluded that daily communication between ID and critical care clinicians on an AMS round provides further benefits to those provided by a dedicated AMS pharmacist.

DiazGranados also described the impact of an ID physician participating in multidisciplinary ICU rounds three times a week to provide feedback on infection management and antimicrobial use.<sup>50</sup> Emergence of antimicrobial resistances was significantly less frequent during the intervention (17% versus 31% at baseline), and rates of selection of appropriate antimicrobials were significantly higher during the intervention than at baseline (82% versus 70%).

Formalised lines of reporting and accountability for advice given by the ID physician are required. This might be achieved through contracts, protocols, policies and other formal agreements. These arrangements should cover:

- ID physician oversight of the patient's progress
- Online access to pathology and radiology results, and other resources required to optimise advice
- Method of communication, including access to documentation, such as emails, and other information technology (IT) tools, to ensure that recommendations are clear and misinterpretation is avoided
- Requirements for appropriate documentation and secure communication systems to ensure patient confidentiality.

### Primary Health Networks

Objective 2 of the [National Antimicrobial Resistance Strategy](#) calls for effective AMS practices to be implemented across human health and animal care settings. Primary Health Networks are well placed to support the implementation of AMS in general practice.<sup>51</sup> Such initiatives may seek the involvement of ID physicians to advise on AMS strategies and provide expert advice.

### Dental services

As AMS becomes more established in dental practices, professional collaboration will be needed between dental practitioners, pharmacists, medical practitioners and ID specialists to improve prescriber knowledge, understand antimicrobial usage patterns and provide pathways to seek advice in difficult situations.

## 8.4 Support for formularies and approval systems

Restricting the use of antimicrobials through a formulary system with pre- or post-prescription approval is considered an essential component of any hospital AMS program (see Section 3.3 in Chapter 3: [‘Strategies and tools for antimicrobial stewardship’](#)). ID physicians have an important role to play in developing a restricted formulary and managing the approval process. Health service organisations without an on-site ID physician need to consider arrangements for these services.

### 8.4.1 Formularies

ID physicians play an important role in developing and maintaining the antimicrobial section of the organisation's formulary and the list of restricted antimicrobials (see Section 3.3 in Chapter 3: [‘Strategies and tools for antimicrobial stewardship’](#)).

It is important that formulary decisions are informed by local microbiology and resistance data. ID physicians should participate in hospital drug and therapeutics committee procedures for listing antimicrobials on the formulary, including:

- Evaluating requests for new antimicrobials
- Extending indications for existing products
- Recommending products that should be restricted
- Defining the criteria for prescribing restricted products.

This involvement can be achieved through either direct membership of the drug and therapeutics committee or liaison between the committee and the ID department or AMS team. An ID physician should also participate in a regular review of the antimicrobial formulary using facility-specific data on antimicrobial susceptibility to guide decisions.

### 8.4.2 Approval systems

To be effective, antimicrobial approval systems require close collaboration across the multidisciplinary AMS team, especially between the ID physicians (or clinical microbiologists) and the pharmacy service.

It is well accepted that ID physicians (or clinical microbiologists) should be directly involved in the approval process (see Section 3.3 in Chapter 3: [‘Strategies and tools for antimicrobial stewardship’](#)).<sup>5</sup> However, barriers to involvement have been identified, including the time involved in the approval process. To assist in these processes, electronic approval systems may be used, or the approval process may be delegated to ID fellows or clinical pharmacists (with referral to an ID physician for expert advice).<sup>1,52,53</sup>

Requests for antimicrobial approvals provide opportunities to educate prescribers.<sup>5</sup> For example, when a verbal approval is sought by a prescriber, the ID physician has the opportunity to provide management advice and guidance about antimicrobial prescribing.<sup>21,54</sup> This includes advising on what is best for the patient, providing antimicrobial advice that reflects known or predicted antimicrobial susceptibilities, and considering the

future need for antimicrobials. Importantly, ID physician advice does not need to be limited to antimicrobials – it may include suggestions for other appropriate investigations or debulking of infection, or recommending no antimicrobial therapy.

Medical staff in an Australian teaching hospital reported that the advice provided by an approval system managed by the ID department was useful and educational.<sup>21</sup> Sunenshine et al. reported similar findings in their survey of ID physicians in the United States.<sup>5</sup> Most prescribers in the Australian study believed that the advice improved patient outcomes.<sup>21</sup> Concerns that electronic antimicrobial approval systems, such as web-based systems, would reduce personal communication and educational opportunities have been unfounded, and these systems have been shown to enable communication and education while saving ID physicians' time.<sup>52,53</sup> (See Section 4.2.2 in Chapter 4: '[Information technology to support antimicrobial stewardship](#)').

## 8.5 Prescription review with feedback

A key role for ID physicians is reviewing local prescribing practices and providing feedback. Review and feedback strategies are especially important in streamlining antimicrobial therapy.<sup>1</sup> ID physicians have an important role in delivering this and other point-of-care interventions (see Section 3.5 in Chapter 3: '[Strategies and tools for antimicrobial stewardship](#)').

### 8.5.1 Antimicrobial stewardship team rounds

AMS team rounds provide the opportunity for ID physicians to discuss therapeutic options and promote optimal antimicrobial prescribing with the treating clinician at the bedside.<sup>55-57</sup> This may include advice about:

- The appropriateness, dose and frequency, route of administration, and duration of the antimicrobial therapy
- Recommendations for further investigations
- Interpretation of results
- The need to seek further advice from other specialties.

(See Section 3.4 in Chapter 3: '[Strategies and tools for antimicrobial stewardship](#)').

Electronic clinical surveillance systems and other technologies are increasingly being used to identify patients requiring review by the AMS team through techniques such as data mining of healthcare records and automatic electronic alerts (see also Section 4.2.3 in Chapter 4: '[Information technology to support antimicrobial stewardship](#)').<sup>57-59</sup> These systems can support the ID physician to prioritise patients for review. Smith et al.<sup>57</sup> described the institution of daily (Monday–Friday) AMS rounds in a community hospital at which identification of inappropriate prescribing was done through data mining of a newly introduced electronic healthcare record. The program demonstrated a return on investment of 7:1 despite a marked investment in software and the recruitment of one full-time equivalent (FTE) pharmacist and a 0.3 FTE ID physician.

ICUs, dialysis units, oncology wards and bone marrow transplant wards are some of the main areas associated with inappropriate antimicrobial treatment<sup>60</sup>, which AMS team rounds could focus on. At a minimum, ICU patients should have their therapy reviewed by an AMS team that includes an ID physician (see [Intensive care](#)). The NSW Clinical Excellence Commission has published an [information sheet](#) on establishing an antimicrobial liaison round in ICUs.

In rural and remote hospitals, ICU rounds can be supported by telehealth services with the on-duty intensivist and an off-site ID physician. A pharmacist can assist in these rounds by assembling a list of the antimicrobials, doses and start dates for each patient before the round. (See Section 3.4 in Chapter 3: '[Strategies and tools for antimicrobial stewardship](#)').



### 8.5.2 Conflicting advice

Antimicrobial prescribing practices may vary among ID physicians, which can lead to treatment recommendations for individual patients that differ from that of the AMS team, potentially causing professional friction and confusion for the primary clinician.<sup>7</sup> Three options have been described for the AMS team in hospitals with an ID department<sup>9</sup>:

- Patients who have received an ID physician consultation are not reassessed
- Review these patients, discuss any recommendations that differ from the AMS team's view with the ID physician, and come to an agreement
- Review these patients and submit an independent AMS team recommendation.

Yeo et al. described the outcomes of differing treatment recommendations in a large tertiary university hospital where ID physicians and the AMS team provided independent assessments and recommendations.<sup>7</sup> Nineteen per cent of patients had differing recommendations. In most of those cases, ID physicians generally recommended continuation of broad-spectrum antibiotics rather than de-escalation, longer duration of antibiotics or combination antibiotics (particularly for *Pseudomonas aeruginosa* infections). Acceptance of either ID physician or AMS team recommendations was not associated with differences in 30-day mortality or readmission rates, although clinical deterioration rates were lower in patients for whom AMS team recommendations were accepted. The authors of the study noted that the approach of an independent AMS team review of patients who have received an ID physician consultation could be complementary and not result in professional conflict between the two groups, provided there is good communication. Early discussion between ID physicians and AMS teams in circumstances where prescribing advice varies may reduce the number of conflicting recommendations.

## 8.6 Monitoring antimicrobial use and evaluating interventions

Continuous surveillance of antimicrobial use is an essential component of AMS programs. ID physicians have an important role in establishing and evaluating systems for monitoring the overall volume and quality of antimicrobial use in their organisation, and in the collection and use of data for quality improvement (QI). This includes participating in or advising the AMS committee or team about the measures to include in the AMS program (see Chapter 6: '[Measuring performance and evaluating antimicrobial stewardship programs](#)'). Box 8.3 shows the role of ID physicians in monitoring and evaluating antimicrobial use.

The data produced can be used to assess trends in use, such as areas of high use, and identify areas for more in-depth review of use (for example, a drug use evaluation study). This analysis can assist in scoping activities to include in the AMS program and evaluating whether there is any improvement.

ID physicians should also liaise with the AMS pharmacist to coordinate the participation of the hospital in state or national antimicrobial

### Box 8.3: Role of infectious diseases physicians in monitoring and evaluating antimicrobial use

The role of infectious diseases physicians in monitoring and evaluating antimicrobial use includes:

- Advising the antimicrobial stewardship (AMS) committee or team about which indicators to monitor (including structure, process, outcome and balancing measures)
- Monitoring data on quantity and quality of antimicrobial use provided through surveillance programs such as the National Antimicrobial Utilisation Surveillance Program, the National Antimicrobial Prescribing Survey (NAPS) and the Surgical NAPS
- Advising the AMS committee or team about the areas to target for review, or studies to evaluate antimicrobial use
- Assisting in analysing results
- Participating in determining the appropriateness of antimicrobial prescribing – for example, through quality audits or point prevalence surveys
- Helping to produce reports and recommendations for drug and therapeutics, infection control and prevention, medication safety, and health service safety and quality committees.

surveillance systems, such as the [National Antimicrobial Utilisation Surveillance Program](#). ID physicians can help interpret the data and advise on local use. When analysing the data, ID physicians need to be aware of some of the limitations of using defined daily dose per occupied bed day as a measure of use. These limitations include a bias against combination therapy, failure to account for situations in which larger or smaller individual doses may be required, and unsuitability of the measure for paediatric settings<sup>61</sup> (also see Section 6.7.1 in



Chapter 6: [‘Measuring performance and evaluating antimicrobial stewardship programs’](#)).

Auditing the quality of prescribing and compliance with prescribing guidelines, and providing feedback to prescribers are important steps in the QI cycle. They are also an important strategy for promoting the use of guidelines and clinical pathways, and influencing prescribing.<sup>2,3,62</sup> QI audits can also identify whether implementation strategies are effective or whether different approaches are needed (see Section 6.8.3 in Chapter 6: [‘Measuring performance and evaluating antimicrobial stewardship programs’](#)). ID physicians should be involved in audits of the appropriateness of prescribing, such as the various [National Antimicrobial Prescribing Survey](#) audits, including the prescribing of surgical prophylaxis.

## 8.7 Liaison

ID physicians are required to liaise within and between different groups in the organisation, and with external providers such as pharmaceutical companies.

### 8.7.1 Liaison within hospitals

Effective AMS programs require collaboration between the ID department and other departments and committees, including:

- Clinical departments – developing and implementing policies and guidelines, and providing education and feedback on results of audits and drug usage evaluation studies
- Pharmacy workforce – managing restricted formulary and approval systems, and providing expert advice and support for other AMS interventions; this may include consultation when a conflict arises<sup>1</sup>, but should also include regular and free communication and cooperation<sup>16</sup>
- Infection prevention and control workforce – taking a leadership role in the management of the hospital’s infection control and prevention program; this provides the ideal opportunity for AMS activities to enhance infection control practices in the control of outbreaks of resistant organisms
- Immunology workforce – working with the immunology workforce to set up a referral system for diagnosing, skin testing or desensitising patients with a history of antimicrobial allergy

- IT workforce (see also Section 4.2 in Chapter 4: [‘Information technology to support antimicrobial stewardship’](#)) – working with the IT workforce tasked with implementing electronic clinical decision support systems for AMS activities; this could include advising on
  - alerts within electronic healthcare records or clinical decision support software systems to target inappropriate prescribing (such as microbe–antimicrobial mismatch, infection unlikely, inappropriate double coverage, inappropriate dosage), and to identify opportunities to improve antimicrobial use (such as de-escalation and intravenous-to-oral switching)
  - content of order sets
  - electronic surveillance and infection prevention systems
  - access to, and content of, guideline recommendations and treatment algorithms
  - development of electronic approval systems, ensuring that they link to local and national therapeutic guidelines.

### 8.7.2 Interacting with the pharmaceutical industry

Studies of interactions between the clinical workforce and the pharmaceutical industry confirm that those interactions can increase requests for additions to formularies (even when the proposed addition has no therapeutic advantage over existing formulary drugs) and can affect prescribing practices.<sup>63–65</sup> These findings highlight the importance of educating prescribers about the influence of pharmaceutical industry relationships and sponsorship on prescribing behaviour.

ID physicians should be involved in providing this education at undergraduate and postgraduate levels. ID physicians themselves need to exercise caution in their interactions with pharmaceutical companies and their representatives. They should actively support the development and implementation of hospital policies that restrict workforce access to pharmaceutical representatives, and support the adoption of conflict-of-interest guidelines developed by professional societies or colleges. These guidelines should be incorporated into hospital policy and training programs. (See also Section 5.2.4 in Chapter 5: [‘Antimicrobial stewardship education for clinicians’](#).)

## 8.8 Role in education

One of the primary roles of the ID physician is that of educator. This can be performed as part of a multidisciplinary program in hospitals<sup>2</sup> through presentations at grand rounds, or as part of an intervention (for example, during the approval process, or as feedback following a review of antimicrobial prescribing) (see also Chapter 5: '[Antimicrobial stewardship education for clinicians](#)').<sup>4</sup>

ID physicians, especially ID registrars, can make a major contribution to the development of education and its delivery to the workforce. ID registrars are often primarily responsible for providing advice and antimicrobial approvals to other specialties, sometimes to more senior clinicians. They need to have the training to understand the rationale for AMS, and to prescribe and recommend treatment according to guidelines. Early in ID registrars' training, it is useful for an ID physician to review the antimicrobial approvals provided by the registrar and discuss possible choices. Basic skills that should be developed during training include:

- Knowledge of local and national guidelines
- Provision of evidence-based advice
- Interpersonal skills and appropriate delivery of advice
- Involvement of, and escalation to, consultant level to diffuse conflict situations.

ID physicians who are interested in leading AMS programs are encouraged to develop the knowledge and skills required to build, lead and evaluate an AMS program.

Antibiotic Awareness Week, held in November each year, provides a good opportunity for ID physicians to be at the forefront of activities to promote AMS, and educate the workforce and the community about AMR and AMS.

# Resources

- NSW Clinical Excellence Commission: [information sheet on establishing an antimicrobial liaison round in ICUs](#)

- NSW Clinical Excellence Commission: [antibiotic communication tool](#)

# References

1. MacDougall C, Polk R. Antimicrobial stewardship programs in health care systems. *Clin Microbiol Rev* 2005;18(4):638–56.
2. Nathwani D, Scottish Medicines Consortium, Short Life Working Group, Scottish Executive Health Department Healthcare Associated Infection Task Force. Antimicrobial prescribing policy and practice in Scotland: recommendations for good antimicrobial practice in acute hospitals. *J Antimicrob Chemother* 2006;57(6):1189–96.
3. Dellit HT, Owens RC, McGowan JE, Gerding DN, Weinstein RA, Burke JP, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis* 2007;44(2):159–77.
4. Petrak RM, Sexton DJ, Butera ML, Tenenbaum MJ, MacGregor MC, Schmidt ME, et al. The value of an infectious diseases specialist. *Clin Infect Dis* 2003;36(8):1013–17.
5. Sunenshine RH, Leidtke LA, Jernigan DB, Strausbaugh LJ. Role of infectious diseases consultants in management of antimicrobial use in hospitals. *Clin Infect Dis* 2004;38(7):934–8.
6. Paterson DL. The role of antimicrobial management programs in optimizing antibiotic prescribing within hospitals. *Clin Infect Dis* 2006;42(Suppl 2):90–5.
7. Yeo CL, Wu JE, Chung GW, Chan DS, Chen HH, Hsu LY. Antimicrobial stewardship auditing of patients reviewed by infectious diseases physicians in a tertiary university hospital. *Antimicrob Resist Infect Control* 2013;2(1):29.
8. Drew RH, White R, MacDougall C, Hermsen ED, Owens RC. Insights from the Society of Infectious Diseases Pharmacists on antimicrobial stewardship guidelines from the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Pharmacotherapy* 2009;29(5):593–607.
9. Cosgrove SE, Hermsen ED, Rybak MJ, File TMJ, Parker SK, Barlam TF, et al. Guidance for the knowledge and skills required for antimicrobial stewardship leaders. *Infect Control Hosp Epidemiol* 2014;35(12):1444–51.
10. Waters CD. Pharmacist-driven antimicrobial stewardship program in an institution without infectious diseases physician support. *Am J Health Syst Pharm* 2015;72(6):466–8.
11. Brink AJ, Messina AP, Feldman C, Richards GA, Becker PJ, Goff DA, et al. Antimicrobial stewardship across 47 South African hospitals: an implementation study. *Lancet Infect Dis* 2016;16(9):1017–25.
12. Storey DF, Pate PG, Nguyen AT, Chang F. Implementation of an antimicrobial stewardship program on the medical-surgical service of a 100-bed community hospital. *Antimicrob Resist Infect Control* 2012;1(1):32.
13. Day SR, Smith D, Harris K, Cox HL, Mathers AJ. An infectious diseases physician-led antimicrobial stewardship program at a small community hospital associated with improved susceptibility patterns and cost-savings after the first year. *Open Forum Infect Dis* 2015;2(2):ofv064.
14. LaRocco A Jr. Concurrent antibiotic review programs: a role for infectious diseases specialists at small community hospitals. *Clin Infect Dis* 2003;37(5):742–3.
15. Centers for Disease Control and Prevention (US). [Core elements of hospital antibiotic stewardship programs](#). Atlanta (GA): CDC; 2017 [updated 2017 Feb 23; cited 2017 Sep 26].
16. National Institute for Health and Care Excellence. [Antimicrobial stewardship: systems and processes for effective antimicrobial medicine use](#). London: NICE; 2015.
17. Writing group for Therapeutic Guidelines: Antibiotic. *Therapeutic guidelines: antibiotic*. Version 15. Melbourne: Therapeutic Guidelines; 2014.

18. Maxwell DJ, McIntosh KA, Pulver LK, Easton KL. Empiric management of community-acquired pneumonia in Australian emergency departments. *Med J Aust* 2005;183(10):520–4.
19. Teo CK, Baysari MT, Day RO. Understanding compliance to an antibiotic prescribing policy: perspectives of policymakers and prescribers. *J Pharm Pract Res* 2013;43(1):32–6.
20. Barben J, Kuehni CE, Trachsel D, Hammer J. Management of acute bronchiolitis: can evidence based guidelines alter clinical practice? *Thorax* 2008;63(12):1103–9.
21. Bannan A, Buono E, McLaws ML, Gottlieb T. A survey of medical staff attitudes to an antibiotic approval and stewardship programme. *Intern Med J* 2009;39(10):662–8.
22. Byl B, Clevenbergh P, Jacobs F, Struelens MJ, Zech F, Kentos A, et al. Impact of infectious diseases specialists and microbiological data on the appropriateness of antimicrobial therapy for bacteremia. *Clin Infect Dis* 1999;29(1):60–6.
23. Filice G, Abraham J, editors. Infectious diseases involvement for *Staphylococcus aureus* bacteremia was associated with appropriate therapy and fewer relapses. 48th Interscience Conference on Antimicrobial Agents and Chemotherapy; 2008 Oct 25–28; Washington, DC.
24. Roberts R, Hota B, Ahmad I, Scott R, Foster S, Abbasi F, et al. Hospital and societal costs of antimicrobial-resistant infections in a Chicago teaching hospital: implications for antimicrobial stewardship. *Clin Infect Dis* 2009;49:1175–84.
25. Schmitt S, McQuillen DP, Nahass R, Martinelli L, Rubin M, Schwebke K, et al. Infectious diseases specialty intervention is associated with decreased mortality and lower healthcare costs. *Clin Infect Dis* 2014;58(1):22–8.
26. Honda H, Krauss MJ, Jones JC, Olsen MA, Warren DK. The value of infectious diseases consultation in *Staphylococcus aureus* bacteremia. *Am J Med* 2010;123(7):631–7.
27. Della Loggia P, Gherardi V, Pellegrino F, Cocchi I, Esposito R, Kiren V. Improving the appropriateness of antibiotic prescription in hospitals: a pilot study assessing the effectiveness of an infectious diseases specialist's consultation programme. *Int J Antimicrob Agents* 2008;31(5):488–9.
28. Al-Tawfiq J. The pattern and impact of infectious diseases consultation on antimicrobial prescription. *J Glob Infect Dis* 2013;5(2):45–8.
29. Yapar N, Erdenizmenli M, Oğuz VA, Kuruüzüm Z, Senger SS, Çakır N, et al. Infectious disease consultations and antibiotic usage in a Turkish university hospital. *Int J Infect Dis* 2006;10(1):61–5.
30. Osowicki J, Gwee A, Noronha J, Palasanthiran P, McMullan B, Britton PN, et al. The impact of an infectious diseases consultation on antimicrobial prescribing. *Pediatr Infect Dis J* 2014;33(6):669–71.
31. Trubiano J, Phillips E. Antimicrobial stewardship's new weapon? A review of antibiotic allergy and pathways to 'de-labeling'. *Curr Opin Infect Dis* 2013;26(6):526–37.
32. van Dijk SM, Gardarsdottir H, Wassenberg MWM, Oosterheert JJ, de Groot MCH, Rockmann H. The high impact of penicillin allergy registration in hospitalized patients. *J Allergy Clin Immunol Pract* 2016;4(5):926–31.
33. Trubiano JA, Chen C, Cheng AC, Grayson ML, Slavin MA, Thursky KA. Antimicrobial allergy 'labels' drive inappropriate antimicrobial prescribing: lessons for stewardship. *J Antimicrob Chemother* 2016;71(6):1715–22.
34. Charneski L, Deshpande G, Smith SW. Impact of an antimicrobial allergy label in the medical record on clinical outcomes in hospitalized patients. *Pharmacotherapy* 2011;31(8):742–7.
35. Macy E, Contreras R. Health care use and serious infection prevalence associated with penicillin 'allergy' in hospitalized patients: a cohort study. *J Allergy Clin Immunol* 2014;133(3):790–6.
36. Trubiano JA, Worth LJ, Urbancic K, Brown TM, Paterson DL, Lucas M, et al. Return to sender: the need to re-address patient antibiotic allergy labels in Australia and New Zealand. *Intern Med J* 2016;46(11):1311–17.
37. Barlam TF, Cosgrove SE, Abbo LM, MacDougall C, Schuetz AN, Septimus EJ, et al. Implementing an antibiotic stewardship program: guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clin Infect Dis* 2016;62(10):1197–202.
38. Unger NR, Gauthier TP, Cheung LW. Penicillin skin testing: potential implications for antimicrobial stewardship. *Pharmacotherapy* 2013;33(8):856–67.
39. Trubiano JA, Pai Mangalore R, Baey YW, Le D, Graudins LV, Charles PG, et al. Old but not forgotten: antibiotic allergies in general medicine (the AGM Study). *Med J Aust* 2016;204(7):273.



40. Jeffres MN, Narayanan PP, Shuster JE, Schramm GE. Consequences of avoiding  $\beta$ -lactams in patients with  $\beta$ -lactam allergies. *J Allergy Clin Immunol* 2016;137(4):1148–53.
41. Knezevic B, Sprigg D, Seet J, Trevenen M, Trubiano J, Smith W, et al. The revolving door: antibiotic allergy labelling in a tertiary care centre. *Intern Med J* 2016;46(11):1276–83.
42. Hamilton KW, Fishman NO. Antimicrobial stewardship interventions: thinking inside and outside the box. *Infect Dis Clin North Am* 2014;28(2):301–13.
43. Rimawi RH, Cook PP, Gooch M, Kabchi B, Ashraf MS, Rimawi BH, et al. The impact of penicillin skin testing on clinical practice and antimicrobial stewardship. *J Hosp Med* 2013;8(6):341–5.
44. Kollef MH, Micek ST. Antimicrobial stewardship programs: mandatory for all ICUs. *Crit Care* 2012;16(6):179.
45. Gould I. Optimizing antimicrobial chemotherapy in the ICU. In: Gould IM, van der Meer JWM, editors. *Antibiotic policies: fighting resistance*. Berlin: Springer; 2007:209–22.
46. Zhang Y-Z, Singh S. Antibiotic stewardship programmes in intensive care units: why, how, and where are they leading us. *World J Crit Care Med* 2015;4(1):13–28.
47. Vitrat V, Hautefeuille S, Janssen C, Bougon D, Sirodot M, Pagani L. Optimizing antimicrobial therapy in critically ill patients. *Infect Drug Resist* 2014;7:261–71.
48. Tabah A, Cotta MO, Garnacho-Montero J, Schouten J, Roberts JA, Lipman J, et al. A systematic review of the definitions, determinants, and clinical outcomes of antimicrobial de-escalation in the intensive care unit. *Clin Infect Dis* 2016;62(8):1009–17.
49. Rimawi RH, Mazer MA, Siraj DS, Gooch M, Cook PP. Impact of regular collaboration between infectious diseases and critical care practitioners on antimicrobial utilization and patient outcome. *Crit Care Med* 2013;41(9):2099–107.
50. DiazGranados CA. Prospective audit for antimicrobial stewardship in intensive care: impact on resistance and clinical outcomes. *Am J Infect Control* 2012;40(6):526–9.
51. Australian Government Department of Health, Australian Government Department of Agriculture. Responding to the threat of antimicrobial resistance: Australia's first National Antimicrobial Resistance Strategy 2015–2019. Canberra: Department of Health; 2015.
52. Grayson ML, Melvani S, Kirsa SW, Cheung S, Korman AM, Garrett MK, et al. Impact of an electronic antibiotic advice and approval system on antibiotic prescribing in an Australian teaching hospital. *Med J Aust* 2004;180(9):455–8.
53. Agwu AL, Lee CK, Jain SK, Murray KL, Topolski J, Miller RE, et al. A world wide web-based antimicrobial stewardship program improves efficiency, communication, and user satisfaction and reduces cost in a tertiary care pediatric medical center. *Clin Infect Dis* 2008;47(6):747–53.
54. Ohl CA, Luther VP. Health care provider education as a tool to enhance antibiotic stewardship practices. *Infect Dis Clin North Am* 2014;28(2):177–93.
55. Bantar C, Sartori B, Vesco E, Heft C, Saúl M, Salamone F, et al. A hospitalwide intervention program to optimize the quality of antibiotic use: impact on prescribing practice, antibiotic consumption, cost savings, and bacterial resistance. *Clin Infect Dis* 2003;37(2):180–6.
56. Apisarnthanarak A, Danchaivijitr S, Khawcharoenporn T, Limsrivilai J, Warachan B, Bailey TC, et al. Effectiveness of education and an antibiotic-control program in a tertiary care hospital in Thailand. *Clin Infect Dis* 2006;42(6):768–75.
57. Smith T, Philmon CL, Johnson GD, Ward WS, Rivers LL, Williamson SA, et al. Antimicrobial stewardship in a community hospital: attacking the more difficult problems. *Hosp Pharm* 2014;49(9):839–46.
58. Dik J-WH, Hendrix R, Lo-Ten-Foe JR, Wilting KR, Panday PN, van Gemert-Pijnen LE, et al. Automatic day-2 intervention by a multidisciplinary antimicrobial stewardship-team leads to multiple positive effects. *Frontiers in Microbiology* 2015;6:546.
59. Echevarria K, Smith G, Tierney C, Patterson J, Cadena-Zuluaga J. Utility of an electronic clinical surveillance system to facilitate tracking of multidrug-resistant organisms (MDRO) and antimicrobial stewardship in a VA medical centre. *ElectronicHealthcare* 2011;10(2):e30–7.
60. Kollef MH. Inadequate antimicrobial treatment: an important determinant of outcome for hospitalised patients. *Clin Infect Dis* 2000;31(Suppl 4):131–8.
61. Morris AM. Antimicrobial stewardship programs: appropriate measures and metrics to study their impact. *Curr Treat Options Infect Dis* 2014;6(2):101–12.

62. National Health Service. Antimicrobial prescribing: a summary of best practice. London: NHS; 2007.
63. Lexchin J. Interactions between physicians and the pharmaceutical industry: what does the literature say? *CMAJ* 1993;149(10):1401-7.
64. Wazana A. Physicians and the pharmaceutical industry: is a gift ever just a gift? *JAMA* 2000;283(3):373-80.
65. Zipkin DA, Steinman MA. Interactions between pharmaceutical representatives and doctors in training: a thematic review. *J Gen Intern Med* 2005;20(8):777-86.